Concentrated Solar Tower Power Plant using Slag as Inventory Material for a Thermal Energy Storage (TES)

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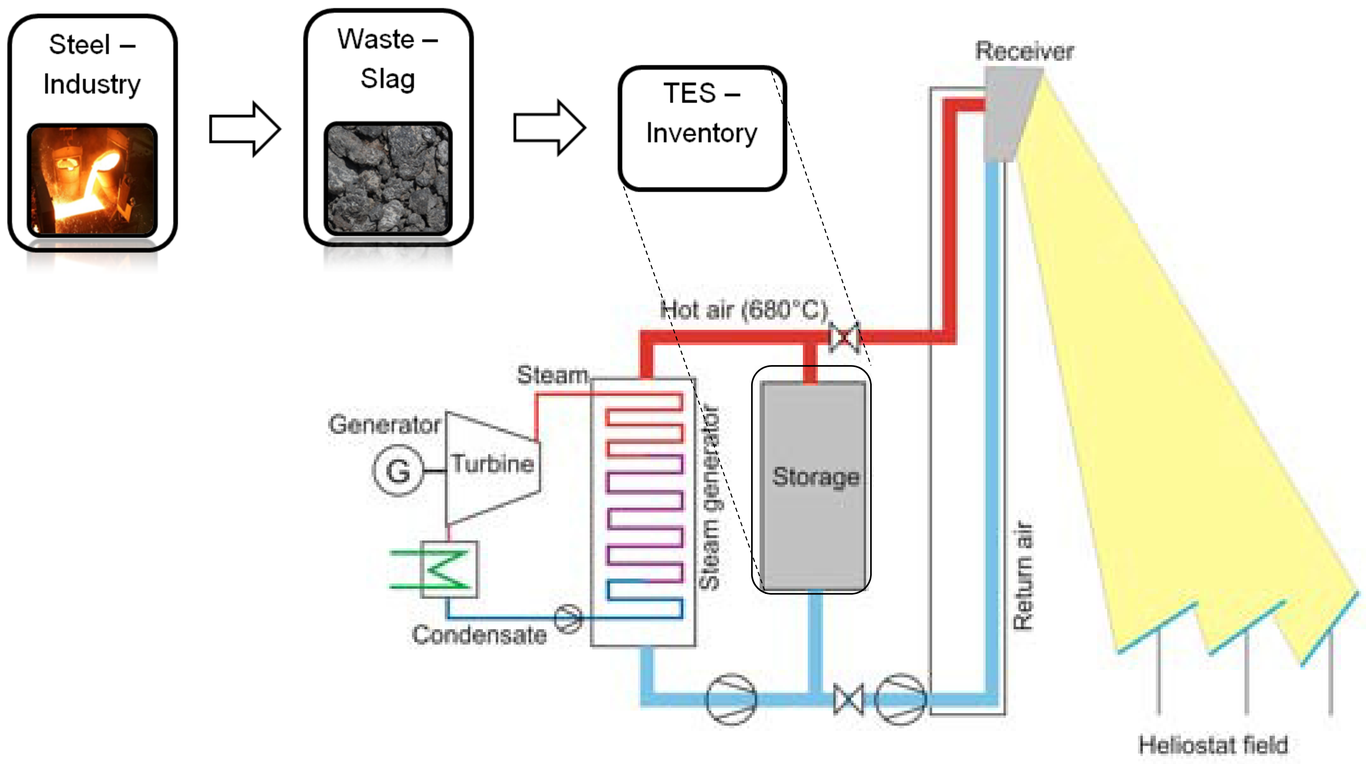
Motivation & Approach

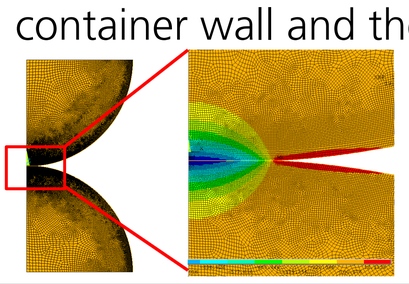
Slag from steel industry as an inventory material for thermal energy storage (TES) of CSP tower plants offers cost reduction potential, due to its classification as waste.

For a successful market introduction of this technology, efficient and up-scalable solutions for the TES are a prerequisite. Investigations to clarify open questions concerning the implementation in large installations in combination with slag-pebbles as inventory are needed. The European project REslag is dedicated to this.



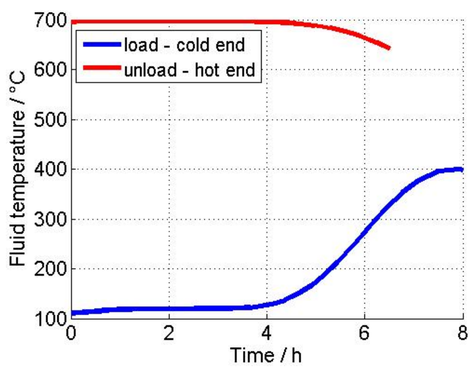
Development activities

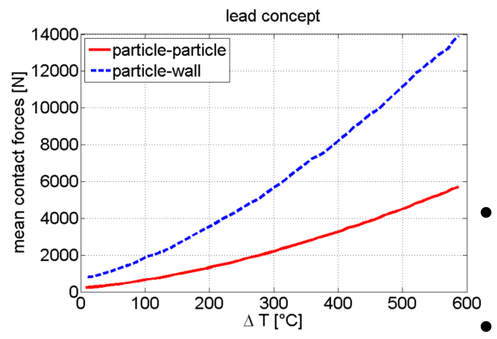
- Conception of TES design
- Thermal analysis of the TES
- Pilot scale tests of a set-up of slag pebbles and various insulation options
- Simulation of flow distribution using different distributors
- Thermo-mechanical calculations of the container wall and the slag pebbles



Full scale CSP plant specifications:	
Net power output	150 MW_{el}
TES discharging duration	6.5 h
TES charging duration	8 h
TES inlet temperature	700 °C
Mass flow discharging	780 kg/s
Mean charging mass flow	706 kg/s

Results





- Max. temperature drop of 60°C of the hot end can be reached
- Steady state conditions can be reached after 8 days
- Highest pressure drop of 87 mbar occurs during solar noon
- Mean pressure drop is 50 mbar
- Several distributors with good uniformity of flow are identified; cylinder distributor of 1m height is most promising
- Increase of contact force with increasing temperature spread
- Higher forces for particle-wall contacts

Summary & Outlook

- Lead concept "Axial flow – vertical" could be identified by using the thermal analysis as well as aptitude and risk analysis
- Distributor concept was identified
- Thermo-mechanical calculations with reduced degree of detail indicate larger forces than expected
- Mechanical and thermal slag analysis is promising
- The full scale lead design was adapted to the pilot scale test rig
  - → upcoming experimental trials will be performed
    - Different insulation options
    - Different load behaviours

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 642067.

REslag
Turning waste into value

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